CBM+ SUCCESS STORIES

USMC LAV Methodology

The S&R Foundation is the Smart Platform

LAV-25 Component Locator

CBM Candidate Master Parts List
53 Parts

Currently lists -2410 tracked parts
And additional life limited parts
---mainly rotating components

Main rotor head
M/R Hub
Trunion damper
Upper bearing
Lower bearing
M/R Swashplate
Swashplate bearing
PC link
PC link rod ends

Air Data Processor
bearing (A-model)
Derotation Unit
(D-model)

Straps
Pitch housing
Lead-lag link
Feathering bearing
Lead-lag damper
Rod end (damper)

Main rotor blade
Tip cap
M/R blade attach pin

Tail rotor head
T/R fork
T/R hub
T/R swashplate & bearing
T/R PC links
T/R strap
T/R blade

Intermediate GB
T/R GB
Drive Flange
Hanger Bearing (FWD and AFT)

Main Transmission
Clutch (left/right)
ACC clutch (primary/secondary)
M/R drive plate
M/R drive shaft (Gearshaft-spur)

APU
APU clutch
APU shaft

Hydraulic Pump (Primary & Utility)
Lube Pumps
Generator
Shaft Driven Compressor (A-model only)

Engine (No. 1 & 2)
Nose GB (No. 1 & 2)
Quill Shaft
Engine Starter

Diagnostics Exist

Prognostics

Status 19 April 05

Implementing CBM Today

Aviation Engineering Directorate Developing AW

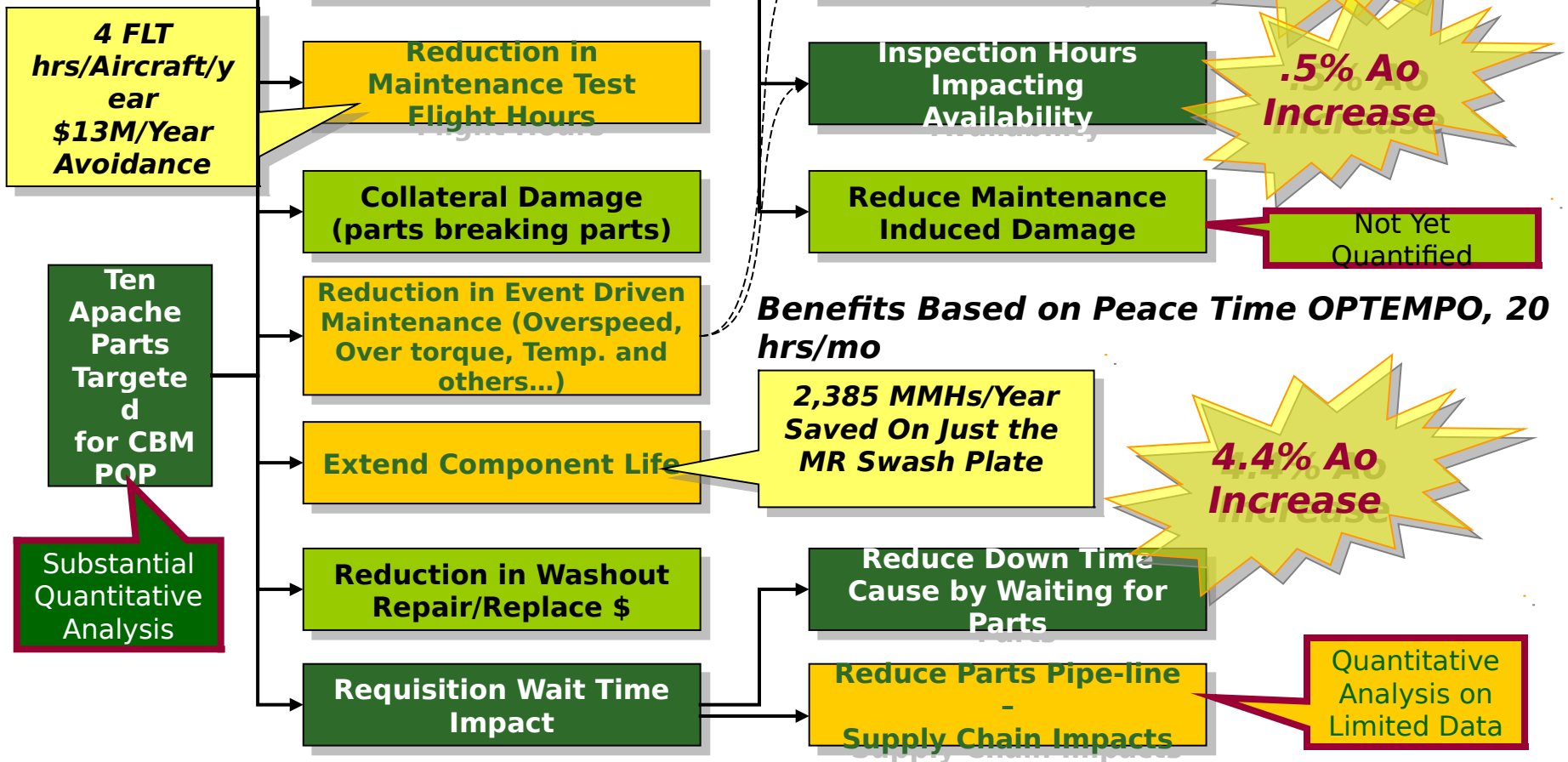
SYSTEM	ITEM	ACTION / BENEFIT
AH-64	M/R Swashplate	AWR eliminates 50 Hr bearing inspection (between 1750 and 2250 hrs)
AH-64	APU Clutch	AWR eliminates Vibration Checks at installation and Phase
AH-64	Aft Hanger Bearing	Safety Improvement w/ continuous diagnostic monitoring
AH-64	Fwd Hanger Bearing	Safety Improvement w/ continuous diagnostic monitoring
UH-60	Oil Cooler Axial Fan Bearing	AWR authorizes continuous CBM monitoring to eliminate 120 hr check
UH-60	Engine Output Drive Shaft	AWR authorizes continuous CBM monitoring to eliminate 120 hr check

- AWRs are under development
- AH-64 AWR releases will enable CBM process on instrumented A/C
- UH-60 AWR releases will enable CBM process on instrumented A/C

Benefit: Readiness & MMH Savings

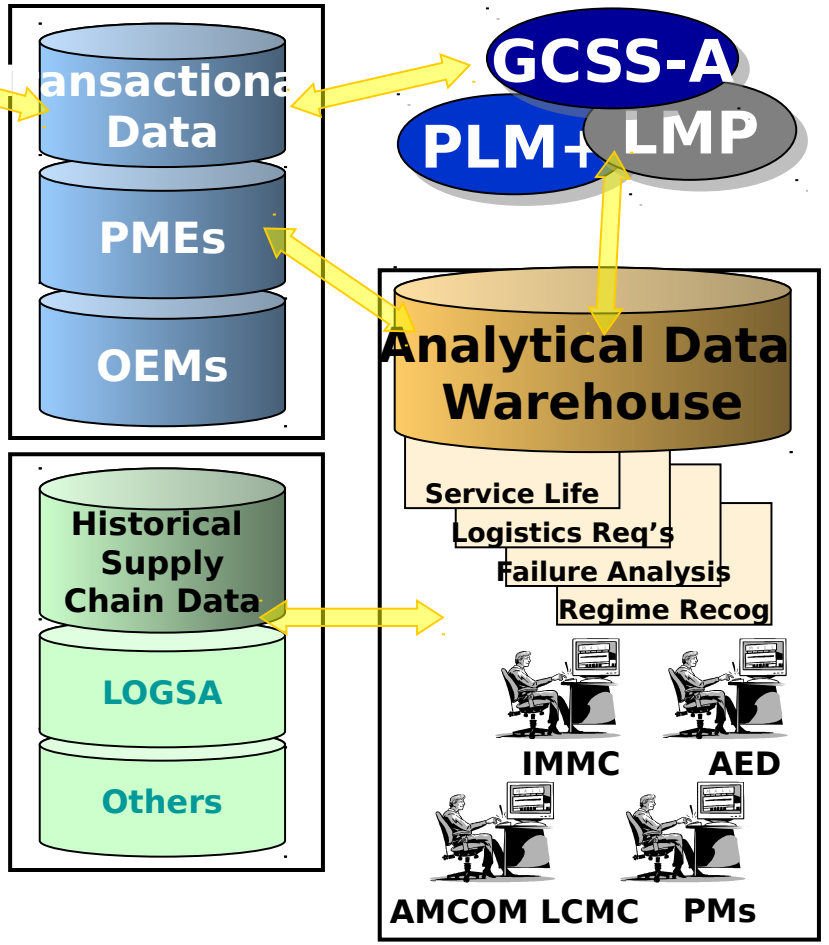
(Blk III Apache)

Initial Cost Benefit Analysis for AMC G8 and DASA-CE



Bottom Line: Savings equate to one additional battalion of combat power per year in the fleet!

Condition Based Maintenance (CBM)



MG JAMES H. PILLSBURY
COMMANDER
US Army Aviation & Missile Command

CLOE Benefits To The Warfighter

Platform/Soldier

- At-platform digital data
- Reduced reporting burden
- Rapid, flexible log commo
- Multi-platform CPME

Tactical CDR

- Enhanced SA
- Improved mission turnaround
- Improved combat readiness

FMT

- One trip with the right parts & tools to complete the job the first time
- Supervisors have info to move resources to meet needs

Logistician

- Near real-time platform/fleet status
- Tailor log requirements - parts, ammo & fuel
- Improved logistics SA

Life Cycle Manager

- Improved safety management
- Enhanced fleet management
- PM/OEM can focus product improvements on reliability drivers
- Accurate forecasting

Enterprise

- 2-way CBM data flow
- Accurate demand forecasting
- Fill pipeline based on actual consumption
- Suppliers get more lead time to meet demand
- Increased component surveillance

Joint Strike Fighter

Prognostics and Health Management

Performance Monitoring / Trending
PTMS (IPP, Filters, Reservoirs, Coalescer, etc.)
Hydraulic System (Pumps, Filter, Reservoirs, Accumulators)
Fuel System (Pumps, Valves, Heat Exchanger)
Weapon Bay Door Drive (Pump Speed & Swashplate Angle)
Rotary Actuators, EHAs
Weapon Racks
OBIGGS Filter

Cross-Comparison (Redundancy Manageme
Flight Controls (VMC, Inceptors, EHAs, Sens
EPS (Degraded modes, Emergency Power)
Fuel Probes

Capacity Trending
28 & 270 volt Batteries
Cryo Cooling Capacity
ESA (loss of Elements)
OBIGGS / OBOGS
HIPPAG Recharge Rate

Auto Calibration / Gain Trending
Radar
Displays
Fuel Probes
Stick & Throttle

Information Management
Model-Based Reasoning,Trending, Pattern Recognition (Enhanced Diagnostics, Fault Isolation)

Enhanced Sensor Technologies
Engine - FOD Detection, Oil Debris, Oil Condition, Blade Tip Monitoring, Vibration Monitoring
SDLF - FOD Detection, Oil Debris, Oil Condition, Shaft Alignment / Torque, Clutch Wear / Vibration
Brake Temperature
Landing Gear (Strut Servicing, 'Smart Tire')

Operational Loads/Usage Monitoring
Structures, Landing / Arresting Gear
Gun, EPS Starter/Generator
CSMU (Write Cycles)

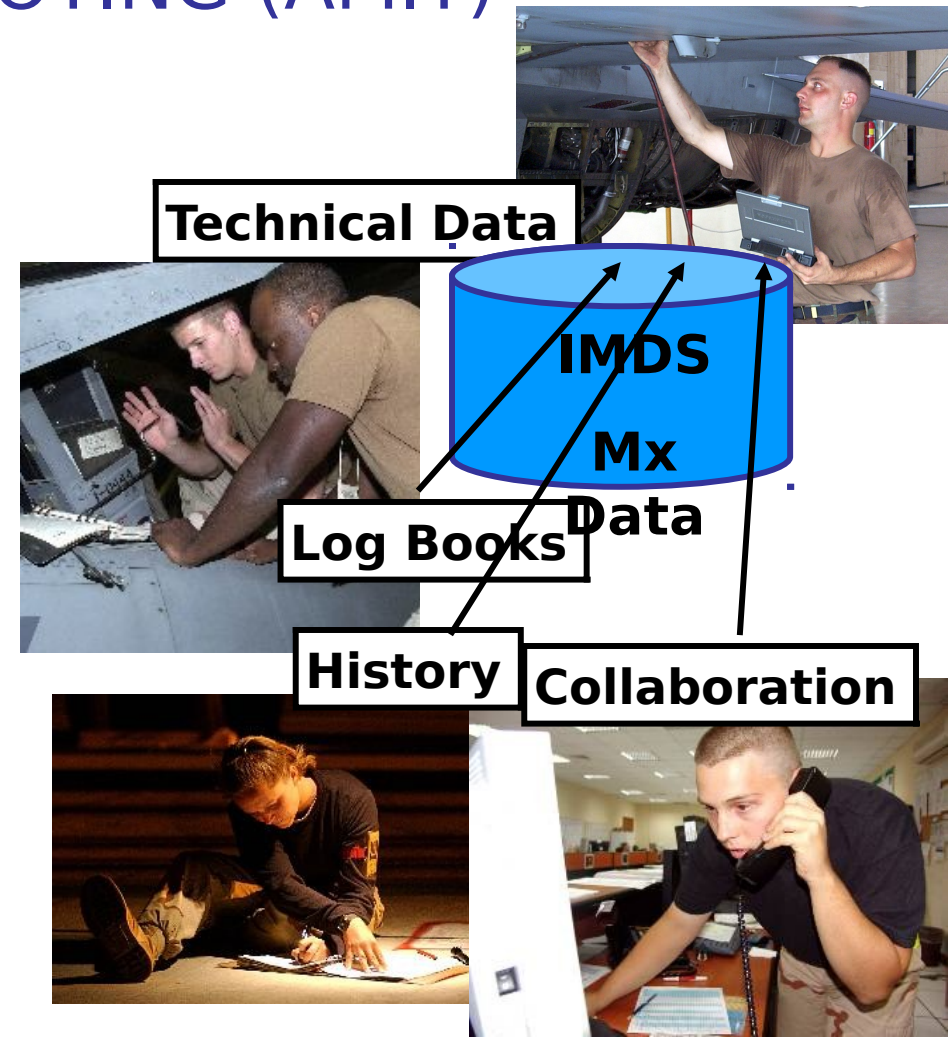
Automated Testing
WBDD Actuator Backlash
External Fuel Tanks
RIOs, VSP Software
Nose Wheel Steering Friction Co
CSMU (Periodic Read/Write Test
Aircraft Wiring

Off-Board Technologies
Diagnostic Tools
Intelligent Help
Prognosis Models

IM Is an Integral Part of Every Facet and Subsystem of the Weapon Syst

Air Force Initiative: AIRCRAFT MAINTENANCE INTUITIVE TROUBLESHOOTING (AMIT)

- AMIT Tool
  - Tech Data presentation that includes
    - Electronic Tech Data
    - Discrepancy, repair, and parts history
    - Shop-level hints, notes, guidance as Log Book Entries
    - Collaborative Tools
  - All at the point of Maintenance (POM)
- Supporting technologies
  - UID, Part number tracking, automated discrepancy reporting (POM-X, AC dowload, etc.), on-board sensors, diagnostics, prognostics, supply interface, POM AFTO-22, POM depot collaboration, EDCL
- FY 06 Field Tests



CG-47 Class Cost Savings Summary (99-03)

- ICAS vs. Non-ICAS (1999 – 2003)
  - 14 ICAS; 13 Non-ICAS Ships (2002 & 2003)
  - 13 ICAS; 14 Non ICAS Ships (1999 –2001)
- Thirteen monitored systems:
  - GTM, GTG, HP Air, LP Air, Distilling, AC, Refer, Fire & SWS, Lube Oil, Fuel Oil, CPP, Steering, MRG
  - Fuel flow meters
- Costs
  - OARS data (1999 – 2003)
  - No Sailor labor included in money saved

Annual Savings (Existing Installs)

- $6.6M
- 165.2 man-years

Class Wide for 15 Life Yr Span

- $192M
- 4779 man-years

Savings & Manpower Reduction

- Maintenance Savings: $347K / ship / year
- Fuel Usage: $126K / ship / year

$473K Savings / ship / yr

11.8 Man-yr savings / ship / yr

Complete Package Figures

- Installation: $329K
- Tech Refresh: $187K
- Support: $25K/yr
- FYDP ROI: 3.55

Pay Back: 11 months / ROI : 3.55

System Expansion, Advanced Diagnostics, Prognostics, DS will impr

Condition Based Maintenance Plus (CBM+)

Description

CBM+ is an umbrella initiative designed to integrate "best-of-breed" maintenance strategies and concepts (including, but not limited to Condition Based Maintenance and Reliability Centered Maintenance) with emerging diagnostics and prognostics technology to increase maintenance efficiency and productivity and decrease weapon system sustainment costs. CBM+ capitalizes on advances in technology and commercial information processing capabilities to support maintenance and logistics operations. CBM+ is not a single-event solution, but a maintenance improvement approach that repeatedly challenges weapons platform and equipment managers to collect meaningful information, analyze system performance, assess new technologies and processes, and implement effective solutions that enable improved capabilities.

Expected Outcomes

Continuous Process Improvement identifies processes within the sustainment value chain which are constraining the delivery of required materiel readiness, and provides the opportunity to substitute better processes. By employing the more efficient processes identified under the CBM+ initiative, the cost of readiness can be reduced up to 20% without reducing materiel availability.

Tier 2 FL Capability: Agile Sustainment

Enables the following Agile Sustainment Capabilities:

- **Industrial base meets routine and surge requirements**
- **Sustaining organizations meet routine and surge requirements**
- **Collaborate with the civilian sector to take advantage of advanced business practices, commercial economies, and global non-military networks**
- **Remotely monitor and diagnose system health and to sense, predict, anticipate, and report failures and consumption, and thus anticipate demand associated with current, modernized, and transformed forces and weapons systems**
- **Upgrade current systems and field future weapons systems with designed-in deployability, reliability, maintainability, availability, sustainability, and interoperability to increase readiness and reduce logistics requirements and costs**

Milestones

Sep 05	RCM across DoD assessment
Oct 05	Metrics for CBM+
Jan 06	Annual assessment for Service CBM+Plans
Jul 06	Education and Training Elements for CBM+
Mar 07	Policy Guidance for CBM+